IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Applicants:	Teodor Aastrup et al.		
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Examiner:	John Fitzgerald		
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Customer No.:	29039		
Title:	Piezoelectric Resonator		
Date:	21 January 2008		

Declaration of Teodor Aastrup, Ph.D. Under 37 C.F.R.§1.132

I, Teodor Aastrup, hereby declare as follows:

1. I am a co-inventor of the above-identified patent application entitled "Piezoelectric Resonator." I obtained my MSc degree in materials physics at Uppsala University in Sweden in 1994 and my Ph.D. at the Royal Institute of Technology, Sweden, in 1999. A part of my graduate studies I built my first Quartz Crystal Microbalance (QCM) setup in 1995. I have published 17 peer reviewed publications related to QCM technology. I am able to communicate in the English language.

2. Three publications disclosing Quartz Crystal Microbalance (QCM) sensors published shortly after the priority date of the above-identified patent application have studied the impact of QCM electrode size to the sensitivity of the device[1].

3. Lu et al I states that "the **sensitivity** of QCM also **decreases** as the electrode size **decreases.**"(Page 206, column 2, line 15) (emphasis added). Lu et al. I goes on to state that "Since the QCM is mostly used to detect the thickness of absorbtion, **larger electrode size provide higher sensitivity to thickness of absorbtion.**" (Page 207, column 1, line 6) (emphasis added). Figure 3 presented in Lu et al. I (reproduced below) shows that the mass sensitivity of the QCM

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[1] F. Lu, H.P. Lee, S.P. Lim, Quartz crystal microbalance with rigid mass partially attached on electrode surfaces, *Sens. Actuators* 112 (3–4) (2004) 203–210 [Lu et al. I]
F. Lu, H.P. Lee, P. Lu, S.P. Lim, Finite element analysis of interference for the laterally coupled quartz crystal microbalances, *Sensors and Actuators A* 119 (2005) 90–99 [Lu et al. II]
D.H. Wu, J.T. Yng, T.Y. Yu, Robust design of quartz crystal microbalance using finite element and Taguchi method, *Sens. Actuators B* 92 (2003) 337–344

will be impaired if the electrode diameter is decreased. D is the electrode diameter and h is the thickness of the crystal, here 0.2mm.

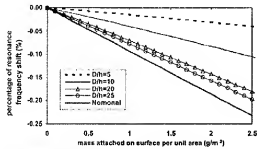


Fig. 3 Frequency sensitivity of QCM as a function of mass absorption unit area with different size of electrode size.

4. Lu et al. II elaborate further on the relationship between sensor electrode dimensions and sensitivity. Specifically, Lu et al. II states: "The mass sensitivity of the single QCM as a function of the electrode width is shown in Fig. 4. It is seen that the mass sensitivity is related to the electrode size. With increasing electrode width, the mass–frequency sensitivity approaches towards the results evaluated from Sauerbrey equation. When the electrode size is smaller, the difference between Sauerbrey equation and FEM result is quite larger. This can be explained that when the electrode width is smaller, a larger amount of vibration energy is dispersed into the surrounding quartz plate outer of the electrode region." (Page 93, column 1, line 13). Figure 4 from Lu et al. II is presented below.

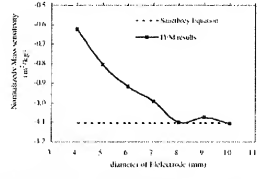
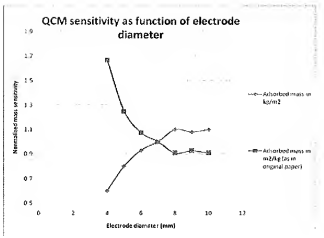


Fig. 4 Normalized mass sensitivity of single QCM ψ_f as a function of the electrode diameter.

5. I have re-drawn Figure 4 from Lu et al. II to show the comparative data from Lu et al. II in a less confusing manner below:



6. Wu et al. in 2003 discloses design parameters for QCMs by means of finite element analysis. Wu et al. report in Figure 10 of the paper (parameter B as described in Table 6), that increasing the radius of a QCM from 2mm to 3mm significantly improves the signal to noise ratio, *i.e.*, the sensitivity of the device.

7. My conclusion from the disclosures of Lu et al. I, Lu et al. II and Wu et al. is that all three references suggest to increase the area or size of the electrodes in QCM for improving sensitivity and not make the electrodes smaller as we have done in our invention.

8. All statements that I make herein of my own knowledge are true and all statements made on information and belief, are believed to be true. I acknowledge that willfully making false statements and the like are punishable by fine, imprisonment, or both, under 35 U.S.C.§1001, and that such willful, false statement may jeopardize the validity of any patent issuing from this patent application.

Signed the 21st day of January 2008 in Stockholm, Sweden

Teodor Aastrup, Ph.D.